

SOLAR RADIATION AND SUNSPOT DATA FOR JUNE 1940

SOLAR RADIATION OBSERVATIONS

BY HELEN CULLINANE

Measurements of solar radiant energy received at the surface of the earth are made at nine stations maintained by the Weather Bureau, and at 10 cooperating stations maintained by other institutions. The intensity of the total radiation from sun and sky on a horizontal surface is continuously recorded (from sunrise to sunset) at all these stations by self-registering instruments; pyrheliometric measurements of the intensity of direct solar radiation at normal incidence are made at frequent intervals on clear days at three Weather Bureau stations (Washington, D. C., Madison, Wis., Lincoln, Nebr.) and at the Blue Hill Observatory at Harvard University. Occasional observations of sky polarization are taken at the Weather Bureau stations at Washington and Madison.

The geographic coordinates of the stations, and descriptions of the instrumental equipment, station exposures, and methods of observation, together with summaries of the data obtained, up to the end of 1936, will be found in the MONTHLY WEATHER REVIEW, December 1937, pp. 415 to 441; further descriptions of instruments and methods are given in Weather Bureau Circular Q.

Table 1 contains the measurements of the intensity of direct solar radiation at normal incidence, with means and their departures from normal (means based on less than 3 values are in parentheses). At Lincoln the observations are made with the Marvin pyrheliometer; at Washington, Madison, and Blue Hill they are obtained with a recording thermopile, checked by observations with a Smithsonian silver-disk pyrheliometer at Washington and Blue Hill. The table also gives vapor pressures at 7:30 a. m. and at 1:30 p. m. (75th meridian time).

Table 2 contains the average amounts of radiation received daily on a horizontal surface from both sun and sky during each week, then departures from normal and the accumulated departures since the beginning of the year. The values at most of the stations are obtained from the records of the Eppley pyrheliometer recording on either a microammeter or a potentiometer.

Direct solar radiant energy averaged considerably below normal at Washington, D. C., while at Lincoln and Madison it slightly exceeded the normal amount.

Total solar and sky radiation considerably exceeded the normal amount at Washington, Madison, Chicago, and New York, and was somewhat in excess at Lincoln. It was markedly deficient at La Jolla, Fairbanks, and Blue Hill, and somewhat so at New Orleans and Riverside.

Polarization observations made at Madison on 5 days give a mean of 70 percent, with a maximum of 71 percent on the 30th. Both of these values are slightly above the corresponding June normals.

TABLE 1.—Solar radiation intensities during June 1940

[Gram-calories per minute per square centimeter of normal surface]

WASHINGTON D. C.												
Date	Sun's zenith distance										Local mean solar time	
	7:30 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°		1:30 p. m.
	75th mer. time	Air mass										
		A. M.					P. M.					
e	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e		
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.	
June 3	13.64				0.55	0.77	1.04				12.24	
June 4	14.60		0.25	0.57		0.65					10.97	
June 13	17.96					0.90					16.79	
June 14	15.11					0.85					15.11	
June 20	5.56					0.90					6.50	
June 21	6.50					0.40					6.50	
June 22	8.18					0.38					8.18	
Means			(0.25)	(0.46)		.69	(1.04)					
Departures			-.43	-.33		-.20	-.21					

MADISON, WIS.											
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.
June 5	15.11	0.52	0.55	0.75	0.91						15.65
June 14	7.57		.58	.68							14.10
June 15	10.18	.75	.91	1.07	1.24	1.45					7.87
June 19	7.39	.81	.94	1.04	1.30	1.48					6.27
June 20	6.27	.91	1.03	1.14	1.31	1.53					6.27
June 21	7.87	.88	.94	1.07							7.29
June 25	10.59	.77	.90	1.04	1.16	1.47					8.48
June 27	9.83	.84	.95								8.18
June 28	13.61				1.18	1.45					9.83
June 29	8.48	.86	.98	1.11	1.30	1.47					7.87
Means		.79	.86	.99	1.20	1.48					
Departures		+.03	+.01	+.02	+.15	+.14					

LINCOLN, NEBR.											
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.
June 1	11.38	0.65	0.78	0.93	1.14	1.43					12.24
June 8	11.38	.66	.77	.92	1.13	1.41	1.13	0.92	0.77		12.24
June 27	11.38					1.45	1.06	.77			13.13
June 29	7.04	.89	.99	1.10	1.24	1.42					8.48
Means		.73	.85	.98	1.17	1.43	(1.10)	(0.84)	(0.77)		
Departures		-.02	+.06	+.04	+.06	+.07	.00	-.07	.00		

BLUE HILL, MASS.											
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.
June 1	13.7					1.20		0.77	0.66		14.7
June 2	12.7					1.30	0.86	.64	.48	0.38	12.3
June 3	13.7	0.44	0.57	0.72	0.93	1.30	0.86	.64	.48	0.38	14.3
June 4	12.8					1.08	.88	.56			9.9
June 5	15.3					.75					14.3
June 6	11.5	.56	.74	.89	1.10	1.42	1.17				6.3
June 7	7.9					1.43	1.16				7.9
June 14	6.3	.91	1.01	1.14	1.29	1.47	1.19	.99	.87	.76	6.5
June 16	7.6	.76	.84	.94	1.12	1.43	1.18	1.04			7.4
June 17	8.2					.89					8.6
June 20	6.1	.92	1.02	1.03	1.27	1.47	1.19	1.07	.94		6.1
June 21	6.5	.80	.98	1.11	1.26	1.41					6.5
June 22	6.5	.86	.99	1.10	1.26	1.42					6.5
June 23	7.4	.88	.99	1.10	1.26	1.47	1.34	1.20			5.2
June 27	11.5					1.37					8.6
June 28	10.7	.80	.93	1.09	1.12	1.38					8.6
June 30	8.8	.69	.81	.94	1.12	1.32					7.9
Means		.76	.89	1.01	1.11	1.37	1.12	.90	.74	.57	
Departures		+.01		.00	+.03	+.07	+.04	-.05	-.04		

* Extrapolated.

TABLE 2.—Average daily totals of solar radiation (direct + diffuse) received on a horizontal surface

[Gram-calories per square centimeter]

Week beginning—	Washington	Madison	Lincoln	Chicago	New York	Fresno	Albuquerque	Fairbanks	La Jolla	Miami	New Orleans	River-side	Blue Hill	Newport	Friday Harbor	Ithaca	Cambridge
June 3.....	cal. 582	cal. 565	cal. 551	cal. 566	cal. 601	cal. 721	cal. 776	cal. 492	cal. 366	cal. 436	cal. 387	cal. 503	cal. 523	cal. 589	cal. 622	cal. 564	cal. 550
June 10.....	501	548	497	450	469	709	693	489	328	482	304	562	386	468	554	500	454
June 17.....	461	546	551	525	569	746	654	497	552	534	490	643	589	635	603	524	654
June 24.....	656	638	711	530	446	652	651	412	408	371	436	600	405	453	605	334	455

DEPARTURES FROM WEEKLY NORMALS

June 3.....	+71	+48	-2	+105	+152	+43	.....	+15	-170	-64	-74	-46	-4	+26	0	+87	.....
June 10.....	-3	+37	-51	-3	+18	+3	.....	-13	-207	+2	-164	-35	-116	-67	+146	+19	.....
June 17.....	-31	+15	-32	+49	+126	+18	.....	-16	-10	+126	+18	+36	+33	+87	+147	+45	.....
June 24.....	+128	+101	+106	+80	+4	-62	.....	-31	-125	-98	+40	+4	-84	-118	+156	-99	.....

ACCUMULATED DEPARTURES ON JUNE 30

	+413	+1,792	-1,379	+1,351	+4,683	-1,456	+2,660	-5,005	+2,296	+3,964	-2,492	-3,178	-2,475	+5,992
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POSITIONS AND AREAS OF SUN SPOTS

[Communicated by Capt. J. F. Hellweg, U. S. Navy (Ret.), Superintendent, U. S. Naval Observatory.] Data from measurements at the U. S. Naval Observatory from plates obtained at the observatories indicated. Difference in longitude is measured from the central meridian, positive toward the west. Latitude is positive toward the north. Areas are corrected for foreshortening and expressed in millionths of Sun's hemisphere. For each day, below longitude, latitude, area of spot or groups, and spot count, are given, respectively, the assumed longitude of the center of the disk, assumed latitude of the center of the disk, total area of spots and groups, and total spot count.

Date	East-ern stand-ard time	Mount Wilson group No.	Heliographic				Area of spot or group	Spot count	Plate quality	Observatory
			Dif-ference in-longi-tude	Lon-gi-tude	Lat-itude	Dis-tance from center of disk				
1940 June 1...	h m 8 45	6852	-75	252	-8	76	6	1	VG	Mount Wil-son.
		6851	-28	299	-7	30	6	1		
		6848	-20	307	-6	22	12	8		
		6850	-13	314	-12	18	12	5		
		6847	+39	6	-11	40	267	1		
		6845	+73	40	-12	74	388	13		
		6844	+73	40	+22	75	12	3		
			(327)	(-1)		703		32		
June 2...	11 38	6856	-84	228	-15	84	145	3	F	U. S. Naval.
		6852	-62	250	-7	63	6	7		
		6854	-17	295	+5	18	24	1		
		6848	-6	306	-6	9	97	10		
		6850	+3	315	-12	12	73	3		
		6853	+51	3	+12	53	24	3		
		6847	+53	5	-11	54	339	1		
		6845	+81	33	-13	81	97	1		
			(312)	(0)		805		29		
June 3...	11 14	6856	-70	229	-15	71	242	2	VG	Do.
		6855	-22	277	-20	29	170	11		
		6854	-4	295	+4	7	48	4		
		6848	+8	307	-6	10	145	13		
		6850	+16	315	-12	20	170	16		
		6853	+62	1	+12	64	97	7		
		6847	+67	6	-11	68	339	1		
			(299)	(0)		1,211		54		
June 4...	11 36	6856	-57	229	-15	59	194	1	VG	Do.
		6857	-15	271	-19	24	48	7		
		6855	-9	277	-20	22	291	15		
		6851	+11	297	-8	13	12	6		
		6848	+21	307	-7	22	145	18		
		6850	+30	316	-12	32	170	13		
		6853	+75	1	+12	76	12	2		
		6847	+80	6	-11	80	339	1		
			(286)	(0)		1,211		63		
June 5...	13 30	6856	-42	229	-16	45	97	1	VG	Do.
		6858	-38	233	-10	40	24	2		
		6857	-1	270	-19	19	73	16		
		6855	+4	275	-20	20	364	22		
		6848	+36	307	-7	37	48	5		
		6850	+44	315	-12	45	194	10		
			(271)	(0)		800		56		
June 6...	11 4	6861	-82	178	+12	82	727	1	VG	Do.
		6860	-80	180	-7	80	194	2		
		6856	-30	230	-16	34	97	11		
		(*)	-12	248	-7	14	12	3		
		(*)	-7	253	-4	8	6	1		
		6859	-4	256	-8	10	12	4		
		6857	+12	272	-19	22	194	14		
		6855	+17	277	-20	26	388	26		
		6848	+50	310	-7	51	24	4		
		6850	+55	315	-12	56	194	11		
			(260)	(0)		1,848		77		

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	East-ern stand-ard time	Mount Wilson group No.	Heliographic				Area of spot or group	Spot count	Plate quality	Observatory
			Dif-ference in-longi-tude	Lon-gi-tude	Lat-itude	Dis-tance from center of disk				
1940 June 7...	h m 10 40	6860	-76	171	-8	76	194	11	VG	U. S. Naval.
		6861	-70	177	+12	71	679	1		
		6860	-68	179	-8	69	194	1		
		6856	-17	230	-16	23	73	4		
		6858	-12	235	-12	16	12	1		
		6859	+7	254	-8	11	12	4		
		6857	+25	272	-19	31	194	15		
		6862	+27	274	-12	29	48	5		
		6855	+30	277	-20	36	486	20		
		6848	+65	312	-8	66	12	2		
		6850	+69	316	-12	70	339	13		
			(247)	(0)		2,242		77		
June 8...	10 51	6860	-61	172	-8	61	242	23	VG	Do.
		6861	-55	178	+13	57	485	7		
		6860	-53	180	-8	54	194	1		
		6856	-3	230	-16	16	48	1		
		6858	+1	234	-13	13	12	6		
		6859	+17	250	-8	20	48	7		
		6862	+40	273	-11	42	24	7		
		6857	+40	273	-19	44	242	27		
		6855	+45	278	-20	49	533	18		
		6850	+80	313	-12	80	48	2		
			(233)	(0)		1,876		99		
June 9...	11 3	6863	-63	167	+15	55	24	7	VG	Do.
		6860	-45	175	-8	46	242	29		
		6861	-41	179	+12	42	485	1		
		6860	-39	181	-8	40	194	1		
		6865	+10	230	-10	14	6	2		
		6856	+11	231	-15	18	24	2		
		6864	+15	235	-5	16	24	2		
		6858	+16	236	-13	20	24	6		
		6862	+63	273	-10	54	48	6		
		6857	+64	274	-19	57	242	23		
		6855	+69	279	-20	61	533	12		
			(220)	(0)		1,846		89		
June 10...	11 19	6863	-40	167	+16	42	12	7	VG	Do.
		6860	-31	176	-8	32	291	44		
		6866	-28	179	+8	30	12	2		
		6861	-28	179	+12	31	436	7		
		6860	-26	181	-8	27	194	1		
		6865	+23	230	-10	25	48	8		
		6856	+24	231	-15	29	16	2		
		6864	+28	235	-5	29	16	2		
		6858	+30	237	-14	33	16	5		
		6862	+65	272	-10	66	24	3		
		6857	+67	274	-19	68	194	16		
		6855	+72	279	-20	73	388	10		
			(207)	(+1)		1,647		107		
June 11...	10 39	6863	-27	167	+16	30	24	4	VG	Mount Wil-son.
		6867	-26	168	+24	34	24	1		
		6860	-17	177	-8	20	339	41		
		6866	-14	180	+8	15	12	2		
		6861	-13	181	+12	17	339	4		
		6860	-11	183	-8	14	194	1		
		6865	+37	231	-10	38	48	12		
		6856	+38	232	-14	41	12	2		
		6864	+42	236	-5	42	6	2		
		6858	+43	237	-14	45	6	3		
		6857	+82	276	-19	82	97	6		